1. An apparatus for providing chemical and biological detection of molecules adsorbed on an organic self-assembled surface, comprising:

a gate contact;

a gate insulator attached to the gate contact;

a source contact attached to the gate insulator;

a drain contact attached to the gate insulator; and;

a semiconductor layer extending between the source and drain comprising an organic monolayer of molecules, each molecule comprising a sensing end group, a conjugated segment covalently bonded to the sensing end group, and an attaching end group covalently bonded to the conjugated segment and attached to the gate insulator.

2. The apparatus as recited in claim 1, wherein the sensing end group is selected from the group consisting of halides, nitriles, amines, amides, and ketones.

3. The apparatus as recited in claim 1, wherein the attaching end group is selected from the group consisting of trichlorosilyl groups, amines, and carboxylic acid groups.

4. The apparatus as recited in claim 1, wherein the conjugated segment is selected from the group consisting of phenyl-acetylene and phenylene-vinylene.

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5. The apparatus as recited in claim 1, configured such that adsorbed molecules can be selectively removed from the sensing end group by heating the organic self-assembled monolayer and driving off adsorbed species of vapor molecules.

6. The apparatus as recited in claim 1, wherein the sensing end group generates an atomically sharp interface for differentiating between vapor molecules.

7. The apparatus as recited in claim 1, wherein a substance is detected when the sensing end group adsorbs a threshold amount of a desired vapor molecule.

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8. An organic self-assembled transistor fabricated on a silicon substrate, the transistor comprising:

a gate contact;

a gate insulator attached to the gate contact;

a source contact attached to the gate insulator;

a drain contact attached to the gate insulator; and

a semiconductor layer between the source and drain, the layer comprising an organic self-assembled monolayer of molecules.

9. The transistor as recited in claim 8, wherein the organic self-assembled monolayer comprises a pentacene film.

10. The transistor as recited in claim 9, wherein the pentacene film is about 10nm thick.

11. The transistor as recited in claim 8, wherein each molecule of the organic self-assembled monolayer comprises:

a sensing end group;

a conjugated segment covalently bonded to the sensing end group; and

an attaching end group covalently bonded to the conjugated segment and attached to the gate insulator.

12. The transistor as recited in claim 11, wherein the sensing end group can be changed to control the chemical properties of the sensing surface.

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13. The transistor as recited in claim 11, wherein the organic self-assembled monolayer generates an atomically sharp interface for differentiating between vapor molecules via the sensing end group.

14. The transistor as recited in claim 11, wherein the sensing end group is selected from the group consisting of halides, nitriles, amines, amides, and ketones.

15. The transistor as recited in claim 11, wherein the conjugated segment is selected from the group consisting of phenyl-acetylene and phenylene-vinylene.

16. The transistor as recited in claim 11, wherein the attaching end group is selected from the group consisting of trichlorosilyl, amines, and carboxylic acid groups.

17. The transistor as recited in claim 11, wherein charge carrier density of the sensing end group changes according to the adsorption of vapor molecules.

18. The transistor as recited in claim 11, wherein charge mobility of the sensing end group changes according to the adsorption of vapor molecules.

19. The transistor as recited in claim 11, wherein current pulses heat the organic self-assembled monolayer so that adsorbed species of vapor molecules are removed from the sensing end group.

20. The transistor as recited in claim 19, wherein the energy required to heat 3 x 10^{-13} cm^3 of the organic self-assembled monolayer is about 15 pJ.

21. The transistor as recited in claim 11, wherein the sensing end group may be removed and replaced without removing the conjugated segment or the attaching end group.

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22. A process of making an organic self-assembled transistor on a silicon substrate, the process comprising the steps of:

high-temperature processing of the silicon to generate a substrate, a gate, a gate insulator, a source and a drain for the transistor; and

depositing an active organic monolayer between the source and drain, the active monolayer attaching to the gate insulator via an attaching end group.

23. The process as recited in claim 22, wherein the active organic monolayer is deposited using micro-contact printing.

24. The process as recited in claim 23, wherein the depth of the active organic monolayer is between about 3nm and about 10nm.

25. The process as recited in claim 22, wherein the depth of the active organic monolayer is less than about 10nm.

26. The process as recited in claim 22, wherein differential response characteristics of the active organic monolayer vary according to concentration levels of adsorbents on the surface of the monolayer.

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27. The process as recited in claim 22, wherein the active organic monolayer comprises a conjugated segment covalently bonded to said attaching end group and a sensing end group covalently bonded to said conjugated segment.

28. The process as recited in claim 27, wherein the sensing end group can be changed to control the chemical properties of the sensing surface.

29. The process as recited in claim 27, wherein said attaching end group is chemically bonded to the gate insulator.

30. The process as recited in claim 22, wherein the substrate is a silicon substrate and wherein the contacts are metals.

31. The process as recited in claim 30, wherein the contacts are selected from the group consisting of gold, aluminum, silver, platinum, copper, lithium, calcium, and combinations thereof.

32. The process as recited in claim 22, wherein the gate insulator is a high dielectric constant oxide.

33. The process as recited in claim 32, wherein the gate insulator is ytrria stabilized zirconia.

34. The process as recited in claim 32, wherein a dielectric constant of the gate insulator is greater than about 4.

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35. A chemical and biological sensor array system, the system comprising:

an array of organic self-assembled single transistor sensors;

a processing module; and

silicon circuitry connecting the array to the processing module.

36. The system as recited in claim 35, the array of organic self-assembled transistors further comprising at least two organic self-assembled transistor sensors calibrated to detect different vapor molecules.

37. The system as recited in claim 36, wherein the processing module monitors differential responses from organic self-assembled transistors in the array, the processing module detecting changes in the differential responses associated with the adsorption of vapor molecule species.

38. The system as recited in claim 35, wherein the silicon circuitry configured such that the transistor sensors can be packaged as an integrated circuit where the organic self-assembled transistor sensors are exposed to the testing atmosphere.

39. The system as recited in claim 35, wherein the organic self-assembled single transistor sensor comprises:

a transistor including a source, a drain, a gate, and a gate insulator; and

a semiconductor self-assembled monolayer channel bonded to the gate insulator between the source and drain of the transistor, the monolayer changing charge mobility and charge density upon adsorption of vapor molecules.

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40. The system as recited in claim 39, wherein the monolayer comprises individual organic monolayer molecules for self-assembly covalently bonded to other surrounding organic monolayer molecules.

41. The system as recited in claim 40, wherein the monolayer provides maximum response when each of the molecules adsorbs a desired vapor molecule.

42. The system as recited in claim 39, wherein the monolayer provides measurable transistor response changes to low concentrations of less than 10^{-16} moles of analyte molecules.

43. The system as recited in claim 39, wherein the monolayer provides maximum response in the presence of analyte molecules even at low concentrations of about 10^{-16} moles.

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